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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/698,964	10/31/2003	Kenneth O. McElrath	3006.001800/KDG	8810
23720 7590 01/23/2008 WILLIAMS, MORGAN & AMERSON 10333 RICHMOND, SUITE 1100 HOUSTON, TX 77042			EXAMINER ONEILL, KARIE AMBER	
			ART UNIT 1795	PAPER NUMBER
			MAIL DATE 01/23/2008	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/698,964	Applicant(s) MCEL RATH ET AL.	
	Examiner Karie O'Neill	Art Unit 1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 November 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,4,6,8-17 and 63 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,4,6,8-17 and 63 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 31 October 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. The Applicant's amendment filed on November 2, 2007, was received. Claims 1, 6 and 13 were amended. Claims 2-3, 5, 7 and 18-62 have been cancelled. Claim 63 has been added as new.

Claim Rejections - 35 USC § 103

2. The Claim rejections under 35 U.S.C. 103(a), with regard to Claims 1, 5-6 and 12 as being unpatentable over Smalley et al. (US 6,683,783 B1) in view of Kawamura et al. (US 6,706,431 B2) are overcome, because independent Claim 1 has been amended.

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1, 6, 8-17 and 63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smalley et al. (US 6,683,783 B1) and in view of Hampden-Smith et al. (US 2003/0198849 A1).

With regard to Claims 1, 6, and 63, Smalley et al. discloses a method of purifying a mixture comprising single walled carbon nanotubes (SWNT) wherein the SWNT are derivatized with a functional group (column 2 lines 45-48). The single walled carbon nanotubes have a diameter ranging from about 0.6nm up to 3nm, 5nm, 10nm, 30nm,

60nm or 100nm (column 6 lines 60-63), and form a planar mat or "bucky paper" having a thickness of about 100 microns (column 14 lines 43-46). Smalley et al. discloses a catalyst metal comprised of platinum, in contact with the mat of carbon nanotubes. Smalley et al. also discloses wherein the catalyst metal further comprises one or more of the Group VI or VIII transition metals, specifically ruthenium, or chromium, molybdenum, tungsten, iron, cobalt, nickel, rhodium, palladium, osmium and iridium (column 7 lines 4-15 and column 23 lines 33-46). The SWNT exhibit a high level of conductivity, fewer defects than multi-walled carbon nanotubes and are very strong (column 5 lines 49-56). Smalley et al. does not disclose the use of the SWNT to form a fuel cell electrode for use in a proton exchange membrane fuel cell or a direct methanol fuel cell. Smalley et al. also does not disclose wherein the catalyst metal is present in an amount less than $400 \mu\text{g}/\text{cm}^2$ of the planar area of the mat of carbon nanotubes and wherein the electrode provides greater than $1 \text{ mA}/\text{cm}^2$ per $\mu\text{g Pt}/\text{cm}^2$ of the planar area of the mat of carbon nanotubes.

Hampden-Smith et al. discloses electrocatalyst powders for use as electrodes in fuel cells (paragraph 0027). Hampden-Smith et al. discloses the use of homo- and hetero-fullerene and carbon nanotube based materials as active components in the reduction of oxygen (paragraph 109). Hampden-Smith et al. also discloses an electrode structure utilizing platinum as the catalyst and having various surface loading values such as of $0.4 \text{ mg Pt}/\text{cm}^2$ (paragraph 417) and supported active species (platinum electrocatalyst) loading of $0.1 \text{ mg}/\text{cm}^2$ and a current density of $150 \text{ mA}/\text{cm}^2$ (paragraph 38). Therefore, the electrode provides greater than $150 \text{ mA}/\text{cm}^2$ per $100 \text{ pg}/\text{cm}^2$ of the

area of the carbon nanotubes. Therefore, at the time of the invention it would have been obvious to one of ordinary skill in the art to use a catalyst metal present in an amount less than $400 \mu\text{g}/\text{cm}^2$ and wherein the electrode provides greater than $1 \text{ mA}/\text{cm}^2$ per $\mu\text{g Pt}/\text{cm}^2$ of the planar area of the mat of carbon nanotubes of Smalley et al., because Hampden-Smith et al. teaches that the performance of the electrode is primarily judged by reference to the relationship between the cell potential and the current density (paragraph 279, Figure 10) and it is advantageous to achieve a higher current density at a higher voltage and to maximize cell performance at low platinum loading (paragraph 286). Hampden-Smith et al. also teaches that using the absolute minimum amount of platinum catalyst is necessary for proper cell performance and reduces the cell weight and increases the power density of the fuel cell.

With regard to Claims 8-11, Hampden-Smith et al. discloses an electrode structure utilizing platinum as the catalyst and having various surface loading values such as $0.1 \text{ mg Pt}/\text{cm}^2$ (paragraph 417) and $0.05 \text{ mg Pt}/\text{cm}^2$ (paragraph 416). Hampden-Smith does not explicitly teach an electrode with a surface loading of $0.025 \text{ mg Pt}/\text{cm}^2$ or $0.010 \text{ mg Pt}/\text{cm}^2$, however, at the time of the invention it would have been obvious to one having ordinary skill in the art to use the absolute minimum amount of platinum catalyst in the electrode of Smalley et al., because Hampden-Smith et al. teaches this being necessary for proper cell performance and the decrease in the total amount of catalyst required reduces cell weight and increases the power density of the fuel cell. The comparisons discussed in Hampden-Smith et al. evaluate cell performance employing various surface loading values. The comparisons concluded

that the cell performance was virtually identical for a cathode loading of 0.1 mg Pt/cm² and a catalyst loading of 0.4 mg Pt/cm² (paragraphs 415-417). The courts have held that the determination of optimum values of cause effective variable such as catalyst surface loading values require only ordinary skill in the art. See MPEP 2144.05.

With regard to Claims 12, 13 and 17, Hampden-Smith et al. discloses in one embodiment, a proton exchange membrane fuel cell (PEMFC) utilizing the electrocatalyst electrodes for chemical reactions (paragraphs 0101, 0313), and in a second embodiment, Hampden-Smith et al. discloses utilizing a direct methanol fuel cell (DMFC) (paragraph 0314). Therefore, at the time of the invention it would have been obvious to one of ordinary skill in the art to use either a PEMFC or DMFC with the electrode of Smalley et al., because Hampden-Smith et al. teaches that one of the critical requirements for these energy devices is the efficient catalytic conversion of the reactants to electrical energy. A significant obstacle to the wide-scale commercialization of such devices is the need for highly efficient electrocatalyst materials for this conversion process.

With regard to Claims 14-16, Hampden-Smith et al. discloses a membrane electrode assembly (MEA) having a supported active species (platinum electrocatalyst) loading of 0.1 mg/cm² and a current density of 150 mA/cm² (paragraph 38). Therefore, the electrode provides greater than 150 mA/cm² per 100 µg/cm² of the area of the carbon nanotubes. Hampden-Smith discloses that the performance of the MEA is primarily judged by reference to the relationship between the cell potential and the current density (paragraph 279, Figure 10). Therefore, it is advantageous to achieve a

higher current density at a higher voltage and to maximize cell performance at low platinum loading (paragraph 286). Although the current density is not explicitly stated as greater than 10, 50, or 100 mA/cm² per µg/cm², it would have been obvious to one having ordinary skill in the art at the time of the invention to optimize the performance of the MEA (see Claims 66-70 of Hamden-Smith et al.). It has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. See MPEP 2144.05.

5. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Smalley et al. (US 6,683,783 B1) in view of Hampden-Smith et al. (US 2003/0198849 A1) and in further view of Fisher et al (US 6,203,814 B1).

Smalley et al. and Hampden-Smith et al. disclose the fuel cell electrode in paragraph 4 above, but do not disclose wherein the functional group is a carboxylic acid.

Fisher et al. discloses a method of making functionalized nanotubes wherein the graphitic nanotubes or fullerenes are functionalized by chemical substitution (see abstract). Fisher et al. also discloses the use of a polycarboxylic acid in the process to functionalize the carbon nanotubes (column 7 lines 32-41). Therefore, at the time of the invention it would have been obvious to one of ordinary skill in the art to use a carboxylic acid to functionalize the electrode of Smalley et al. and Hampden-Smith et al., because Fisher et al. teaches the presence of the carboxylic acid aiding in the linking of nanotubes to form a mat or lattice layout (column 7 lines 32-46).

Response to Arguments

6. Applicant's arguments filed November 2, 2007, have been fully considered but they are not persuasive.

7. *Applicant's principal arguments are:*

(a) Applicant contends that the combination of Smalley et al. and Fisher et al. is not proper. Fisher et al. is directed toward an entirely different type of nanotubes than those disclosed in Smalley et al.

(b) Applicant contends that the combination of Smalley et al. and Hampden-Smith et al. is not proper. Applicant suggests that Hampden-Smith et al. teaches a larger, substantially spherical electrocatalyst powder having an average particle size of from about 10 to 100nm. Applicant points to paragraphs 0102, 0029 and 0031 to suggest that both the powders and aggregates of powders are substantially spherical.

In response to Applicant's arguments, please consider the following comments:

(a) Smalley et al. teaches a method involving single-wall carbon nanotubes (SWNT). Fisher et al. teaches using fibrils as well as nanotubes or "buckytubes" (see abstract) in the method of making functionalized nanotubes. Although Fisher et al. does not explicitly disclose the used of a "single-wall carbon nanotubes", it would have been obvious to one of ordinary skill in the art to derivatize the SWNT of Smalley et al. with carboxylic acid taught by Fisher et al. in order to permit interaction or linkage of the

nanotubes with substrates to form compositions with unique properties (column 3 lines 46-56 and column 17 lines 6-26). The Fisher et al. reference is used to teach about the type of material used in derivatizing the nanotubes and being able to form a mat out of the carbon nanotubes, as is pertinent to the instant application.

(b) Applicant points to specific embodiments of the Hampden-Smith et al. reference to suggest that the powders and aggregates for the electrocatalyst are spherical. Examiner notes that the definition of aggregate is to bring together; collect into one sum, mass, or body. Hampden-Smith et al. discloses that the electrocatalyst particles or powders refer to aggregate particles that include one or more highly dispersed phases with dimensions on the order of about 1 nanometer to 10 nanometers dispersed over the surface of support particles (paragraph 0102). There are several ways of depositing the powders of the electrocatalyst. A viscous paste of an aggregate electrocatalyst powder is screen printed onto a substrate (paragraph 0203). And in many applications, the electrocatalyst powders are formed into a layer in combination with other materials as part of a device such as a fuel cell (paragraph 0201). Therefore, it can be seen that the electrocatalyst materials do not only have a spherical morphology.

Conclusion

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Karie O'Neill whose telephone number is (571) 272-8614. The examiner can normally be reached on Monday through Friday from 8am to 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Application/Control Number:
10/698,964
Art Unit: 1795

Page 10

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Karie O'Neill
Examiner
Art Unit 1795

KAO

MARK RUTHKOSKY
PRIMARY EXAMINER



1.18.2008